ISSN (print) 0093-4666 © 2015. Mycotaxon, Ltd. ISSN (online) 2154-8889

MYCOTAXON

http://dx.doi.org/10.5248/130.707

Volume 130, pp. 707–715 *July–September 2015*

Four new records of *Lecanoraceae* in China

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Abstract — Four lichen species of *Lecanoraceae*, *Clauzadeana macula*, *Lecidella oceanica*, *Lecidella tumidula*, and *Miriquidica obnubila*, are reported for the first time from China. Detailed descriptions of morphology with high resolution photographs, chemistry, comments, and distribution are provided.

Key words — *Lecanorales*, Asia, taxonomy

Introduction

Lecanoraceae Körb. (*Lecanorales*, *Lecanoromycetes*, *Ascomycota*) contains about 27 genera (Lumbsch & Huhndorf 2010) with more than 800 species worldwide; the largest genus of the family is *Lecanora* Ach., including about 552 species (Kirk et al. 2008). Only 27 lecanoraceous species have been reported from China: two of *Calvitimela* Hafellner, three of *Carbonea* (Hertel) Hertel, eleven of *Lecidella* Körb., two of *Miriquidica* Hertel & Rambold, three of *Pyrrhospora* Körb., and six of *Rhizoplaca* Zopf (Wei 1991, Abbas & Wu 1998, Aptroot & Seaward 1999, Abbas et al. 2001, Aptroot & Sparrius 2003, Obermayer 2004, Zhang et al. 2012a, Zhao et al. 2013). During our research on the lecideoid taxa of *Lecanoraceae* in China, we identified four species new to the country: *Clauzadeana macula*, *Lecidella oceanica*, *L. tumidula*, and *Miriquidica obnubila*.

All three genera (*Clauzadeana* Cl. Roux, *Lecidella*, *Miriquidica*) have *Lecanora*-type asci. *Clauzadeana* was created by Roux (1983) to accommodate a species that differed from *Lecidea* Ach. in several microscopic characters, such as the presence of algal cells in the exciple tissue and below the hymenium, the richly branched and anastomosing paraphyses, and the *Lecanora*-type

ascus structure. *Lecidella* is characterized by dark brown to black lecideine apothecia with a green or olive to brown epithecium, lax and simple paraphyses, simple ascospores, and abundant xanthones as major secondary metabolites. *Miriquidica* can be distinguished from *Lecidella* by a thallus that often has an epinecral layer and different secondary metabolites, usually miriquidic acid, lobaric acid and/or norstictic acid.

Materials & methods

The specimens studied were collected from Liaoning, Sichuan, Xinjiang, and Yunnan provinces in China and are preserved in the Lichen Section of Botanical Herbarium, Shandong Normal University, Jinan, China (SDNU) and the Herbarium, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming, China (KUN). Morphological and anatomical characters were examined using a Nikon SMZ 745T stereomicroscope and Olympus CX21 compound microscope. Lichen substances were identified using the standardized thin layer chromatography techniques (TLC) with solvent system C (Orange et al. 2001). Morphological and anatomical photos of the specimens were taken under an Olympus SZX16 stereomicroscope and an Olympus BX61 compound microscope with an Olympus DP72 camera.

Taxonomic descriptions

Clauzadeana macula (Taylor) Coppins & Rambold, Biblioth. Lichenol. 34: 85 (1989) PLATE 1

THALLUS crustose, areolate, ± 0.25 mm thick, without isidia or soredia; AREOLES angular to irregular, 0.2–0.5 mm in diam., continuous, brown to dark-brown, plane, smooth, with epinecral layer; PROTHALLUS usually present at the thallus margin and between the areoles, black. APOTHECIA rounded, scattered, immersed, 0.15–0.3 mm in diam.; DISC black, plane to slightly convex, epruinose, margins not obvious; EPITHECIUM brown to bluish green, with crystals, N+ purple red; HYMENIUM hyaline, I+ blue, 30–50 µm high; PARAPHYSES often branched and anastomosing, 2 µm wide below, 3–4 µm wide apically; HYPOTHECIUM colorless, 50–60 µm thick. ASCI clavate, 30–40 × 10–11 µm, *Lecanora*-type, 8-spored; ASCOSPORES hyaline, simple, ellipsoid, 7–10 × 4.5–5.5 µm. PYCNIDIA: not observed.

CHEMISTRY — Containing an unknown substance.

SPECIMENS EXAMINED — **CHINA**. **SICHUAN**: Xiangcheng county, Rewu commune, Rechong dairy farm, on siliceous rock, alt. 4400 m, 9.VIII.1981, J.K. Yang 2359 (KUN). **XINJIANG**: Urumqi city, Tianshan mountains, Glacier No.1, on siliceous rock, alt. 3100 m, 26.VIII.2011, L.L. Zhang 20126151 (SDNU); alt. 3800 m, 27.VIII.2012, L. Li 20126471 (SDNU).

COMMENTS — *Clauzadeana macula* is characterized by its saxicolous habit, small and immersed aspicilioid apothecia, colorless hypothecium, and

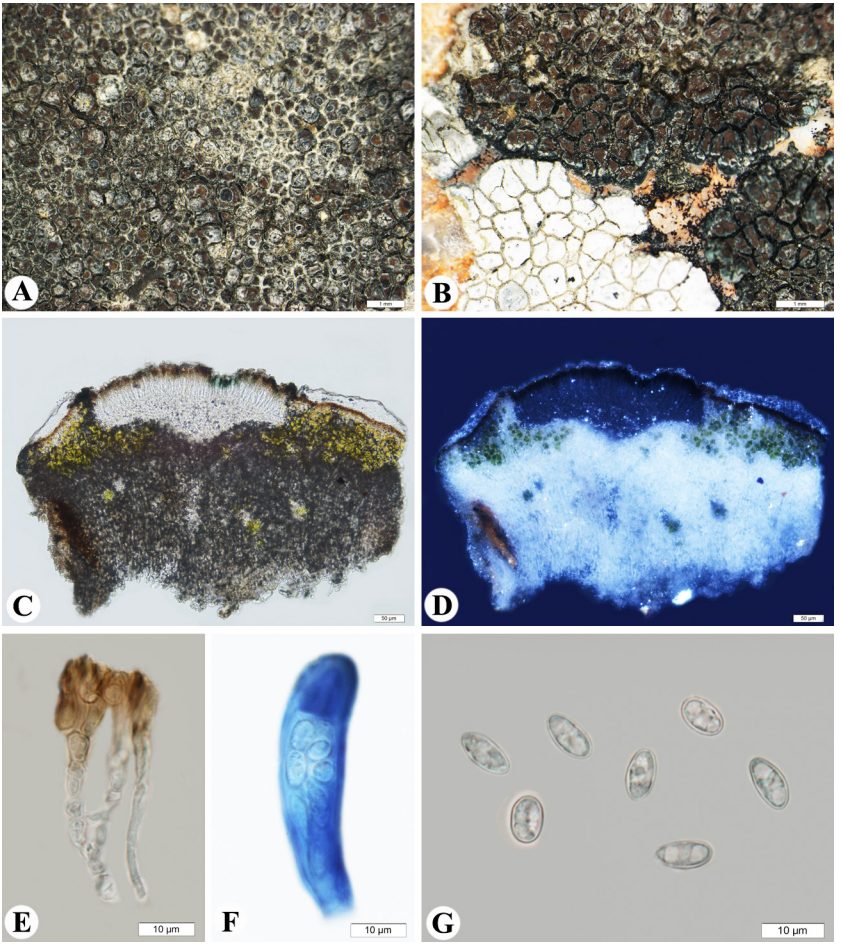

Plate 1. *Clauzadeana macula* (Li 20126471, SDNU). A. Thallus; B. Prothallus; C. Apothecium section; D. Crystals of apothecium section visualized with polarized light; E. Paraphyses; F. Ascus apex reaction; G. Ascospores. Scale bars: A, B = 1 mm; C, D = 50 µm; E–G = 10 µm.

low hymenium. Aspicilioid apothecia also occur in *Amygdalaria* Norman, *Aspicilia* A. Massal., *Immersaria* Rambold & Pietschm., and *Schaereria* Körb., but *Clauzadeana* differs from all of these genera by its *Lecanora*-type ascus structure.

Distribution — *Clauzadeana macula* has been reported from Europe, North America, Asia, and Australasia (Rambold 1989, Nash et al. 2004, Galloway 2007, Smith et al. 2009). New to China.

Lecidella oceanica Lu L. Zhang & Xin Y. Wang, Bryologist 115: 330 (2012) PLATE 2

THALLUS crustose, rimose to areolate, thin, ≤0.15 mm thick, yellow-white, grey-white to greenish grey, smooth to lightly rough, without soredia or isidia; medulla I–; PROTHALLUS absent or present (if present black). APOTHECIA brownish black to black, semi-immersed to sessile, 0.2–0.5 mm in diam.; DISC flat, epruinose; margin distinct to reduced, sometimes lighter than disc; EXCIPLE brown, without algal cells; PARATHECIUM light brown to hyaline, with a small

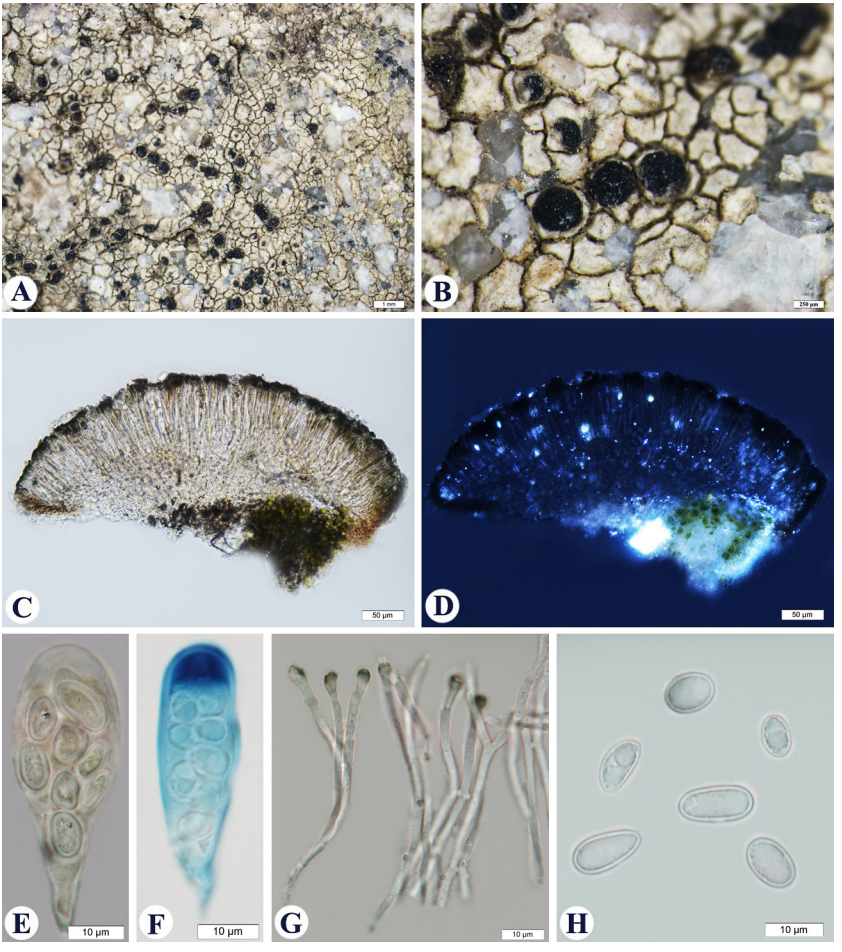

PLATE 2. *Lecidella oceanica* (Cheng 20120798, SDNU). A. Thallus; B. Apothecia; C. Apothecium section; D. Crystals of apothecium section visualized with polarized light; E. Ascus; F. Ascus apex reaction; G. Paraphyses; H. Ascospores. Scale bars: A = 1 mm; B = 250 µm; C, D = 50 µm; E–H = 10 µm.

amount of crystals; EPIHYMENIUM olive, olive-brown to brown; HYMENIUM 50–70 µm tall, with dispersed crystals; PARAPHYSES simple, rarely branched or anastomosing, c. 2 µm wide, slightly thickened apically; HYPOTHECIUM hyaline. ASCI clavate, *Lecanora*-type, 8–spored; ASCOSPORES ellipsoid to broadly ellipsoid, 7.5–13 × 5–7µm. PYCNIDIA not observed.

CHEMISTRY — Containing atranorin (±), 2,5,7-trichloro-3-O-methylnorlichexanthone (capistratone), thiophanic acid, and isoarthothelin.

SPECIMENS EXAMINED — **CHINA**. **LIAONING**: Beipiao city, Mt. Dahei, alt. 1300 m, on siliceous rock, 14.VIII.2011, Y.L. Cheng 20120942, 20120798, 20120933, 20120912B (SDNU); Lvshunkou District, Dongjiacun, alt. 200 m, on siliceous rock, 27.VII.2012, G.L. Zhou 20128775, 20128770 (SDNU).

COMMENTS — *Lecidella oceanica* is morphologically close to *L. enteroleucella* (Nyl.) Hertel in having small apothecia, colorless hypothecium, and similar habitats. *Lecidella enteroleucella* is distinguished by its hymenium without crystals and its secondary metabolites: atranorin, thuringione, and arthothelin.

Our specimens, which represent only the second report of *L. oceanica*, were all collected in Liaoning province near the southwest coast of South Korea (the original collection area). The South Korean specimens have a smoother and lighter-colored thallus (usually yellowish white) and apothecia that are slightly smaller (≤0.3–0.4 mm) than our Chinese specimens. However, the microscopic characters of the Korean and Chinese specimens are nearly the same, and the secondary metabolites are the same.

DISTRIBUTION — *Lecidella oceanica* has previously been reported only from South Korea (Zhang et al. 2012b). New to China.

Lecidella tumidula (A. Massal.) Knoph & Leuckert, Biblioth. Lichenol. 68: 131 (1997) PLATE 3

THALLUS crustose, continuous, rimose to granulose, thin, 0.6–1 mm thick; PROTHALLUS absent; UPPER SURFACE yellowish white, greenish white to greenish grey, dull, without soredia or isidia. APOTHECIA sessile, slightly constricted at base, (0.3–)0.5–0.9 mm in diam.; DISC black, flat to convex, epruinose; margin distinct when young, then excluded; EXCIPLE c. 65 µm thick, green to black green exteriorly, violet brown interiorly, without crystals; EPIHYMENIUM green to blackish green; HYMENIUM hyaline, 50–90 µm tall, with dispersed crystals; PARAPHYSES simple, rarely branched or anastomosing, slightly thickened apically; HYPOTHECIUM reddish brown. ASCI clavate, *Lecanora*-type, 8-spored; ASCOSPORES hyaline, simple, broadly ellipsoid to ovoid, 10–13 × 5.5–7 µm. PYCNIDIA not observed.

CHEMISTRY — Containing lichexanthone and diploicin (±).

SPECIMENS EXAMINED — **CHINA**. **XINJIANG**: Mulei county, Dongdonggou, on bark, alt. 1800 m, 2.VIII.2013, C. Li XL0047 (SDNU); Tianshan mountains, Tianchi, on bark, alt. 2100 m, 23.VIII.2011, L.L. Zhang 20126562 (SDNU); alt. 1900 m, 23.VIII.2011, L.L. Zhang 20126663 (SDNU); alt. 1950 m, 23.VIII.2011, L.L. Zhang 20126512, 20126096

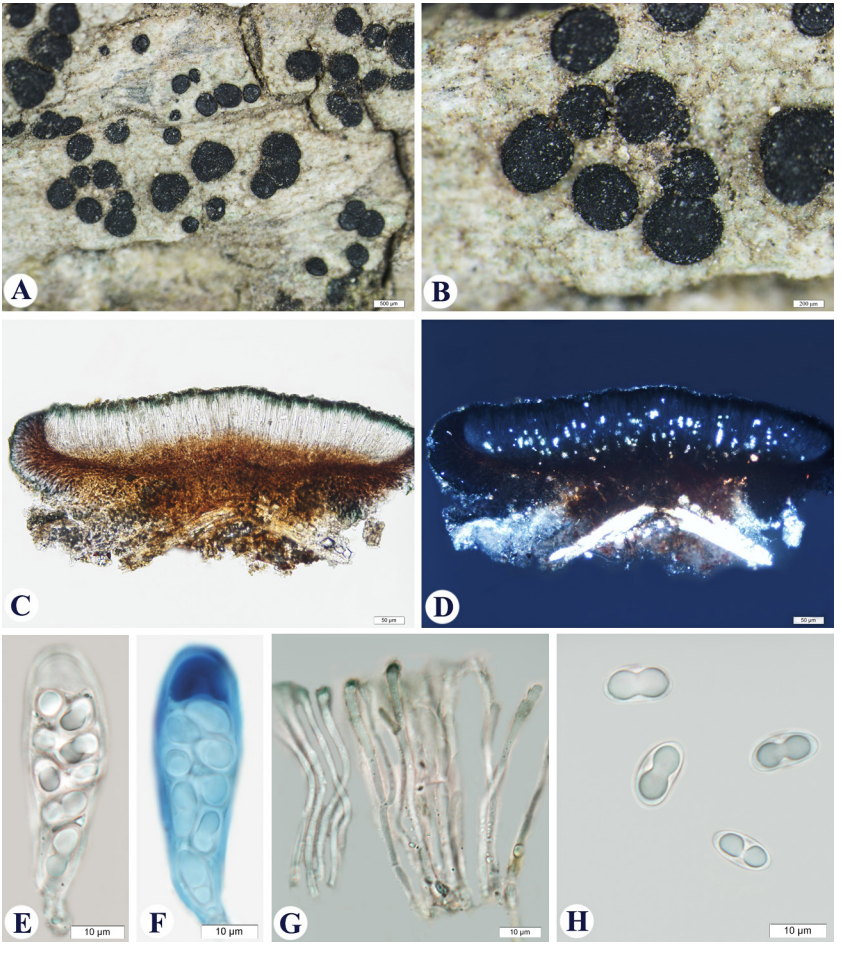

Plate 3. *Lecidella tumidula* (Li XL0047, SDNU). A. Thallus; B. Apothecia; C. Apothecium section; D. Crystals of apothecium section visualized with polarized light; E. Ascus; F. Ascus apex reaction; G. Paraphyses; H. Ascospores. Scale bars: A = 500 µm; B = 200 µm; C, D = 50 µm; E–H = 10 µm.

(SDNU); Urumqi, Nanshan–Xiaoquzi, on bark, alt. 2700 m, 28.VIII.2011, L. Li 20125798 (SDNU); alt. 1900 m, 28.VIII.2011, L.L. Zhang 20126673 (SDNU); alt. 2200 m, 28.VIII.2011, L. Li 20126464, 20125877 (SDNU).

Comments — It is difficult to distinguish *Lecidella tumidula* from *L. elaeochroma* (Ach.) M. Choisy by morphology. However, *L. elaeochroma* has larger (c. 1 mm) apothecia, a thicker hypothecium, larger spores (10–17 × 6–9 µm), and a different chemistry, usually containing several xanthones but never lichexanthone (Knoph & Leuckert 1997, Nash et al. 2004).

Distribution — *Lecidella tumidula* has been reported only from the northern hemisphere in temperate areas of Asia, Europe, and North America (Knoph & Leuckert 1997, Nash et al. 2004). New to China.

Miriquidica obnubila (Th. Fr. & Hellb.) Hertel & Rambold, Mitt. Bot. Staatssamml. München 23: 389 (1987) Plate 4

Thallus crustose, dispersed areolate, c. 0.45 mm thick; areoles irregularly shaped, more or less sublobate, grey, dark grey to rusty colored, plane to

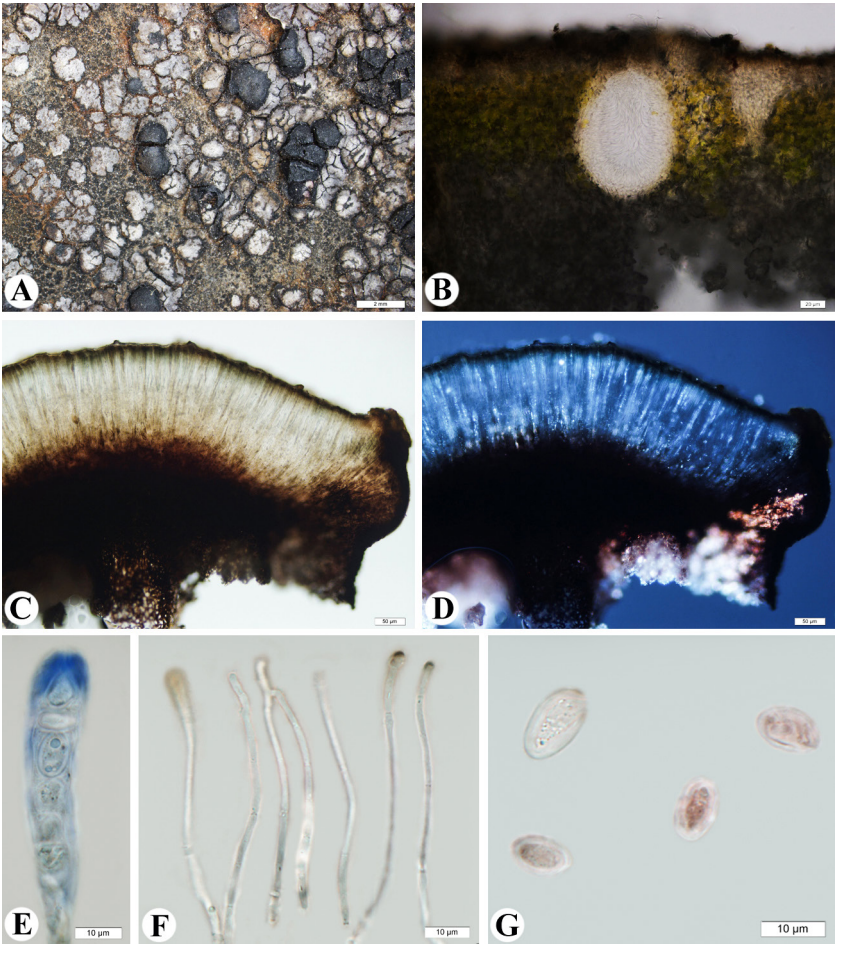

Plate 4. *Miriquidica obnubila* (Zhang 20100347, SDNU). A. Thallus; B. Pycnidium section; C. Apothecium section; D. Crystals of apothecium section visualized with polarized light; E. Ascus apex reaction; F. Paraphyses; G. Ascospores. Scale bars: A = 1 mm; B = 20 µm; C, D = 50 µm; E–G = 10 µm.

irregularly convex, with rough surface, 0.6–1.25 mm diam.; epinecral layer absent; medulla white, I–; HYPOTHALLUS black, obvious at the thallus margin and between the areoles. APOTHECIA roundish, dispersed to crowed, subimmersed to immersed, 0.4–2 mm diam; DISC plane to convex, black-brown to black, epruinose; EXCIPLE distinct, ectal zone blackish brown, inner zone brown to reddish brown; EPIHYMENIUM brown to olive-brown; HYMENIUM hyaline, with crystals; PARAPHYSES rarely branched and anastomosing, 1.5–2 μm wide, c. 3 μm wide apically; HYPOTHECIUM dark reddish brown. ASCI clavate, *Lecanora*-type, 8-spored; ASCOSPORES hyaline, 8–11 × 4.5–7 μm. PYCNIDIA immersed, ± globular; CONIDIA filiform, curved.

CHEMISTRY — Containing miriquidic acid.

SPECIMENS EXAMINED — **CHINA**. **YUNNAN**: Lijiang city, Mt. Laojun, on siliceous rock, alt. 4000 m, 7.XI.2009, L.L. Zhang 20100347 (SDNU); Luquan county, Mt. Jiaozixue, on siliceous rock, alt. 3800 m, 27.X.2008, H.Y. Wang 20082271 (SDNU); alt. 3700 m, 10.IV2010, L.S. Wang 10-31285 (KUN).

COMMENTS — *Miriquidica obnubila* and *M. molybdochroa* (Hertel) Hertel & Rambold are not easily separated. Both species have grey thallus, dark brown hypothecium, and miriquidic acid, but *M. molybdochroa* differs by its non-sublobate areoles and wider spores (usually 6–8 μm wide; Hertel & Rambold 1987)

DISTRIBUTION — *Miriquidica obnubila* has been reported from extra-tropical Asia, Europe, and North America (Rambold et al. 2015, Andreev 2004). New to China.

Acknowledgments

The project was financially supported by Program for Scientific Research Innovation Team in Colleges and Universities of Shandong Province, and the National Natural Science Foundation of China (31170187, 31270059). We are grateful to Prof. Dr. Gerhard Rambold (University of Bayreuth, Germany) and Dr. Alan Fryday (Herbarium, Dept Plant Biology, Michigan State University, USA) for assistance in specimen identification. We also thank Dr. Shou-Yu Guo (State Key Laboratory of Mycology, Institute of Microbiology, Chinese Academy of Sciences, Beijing, China) and Dr. Einar Timdal (Natural History Museum, University of Oslo, Norway) for presubmission reviews.

Literature cited

Abbas A, Wu JN. 1998. Lichens of Xinjiang. Urumqi, Sci-Tech & Hygiene Publishing House of Xinjiang (K).

Abbas A, Mijit H, Tumur A, Wu JN. 2001. A checklist of the lichens of Xinjiang, China. Harvard Papers in Botany 5(2): 359–370.

Andreev MP. 2004. Notes on the lichen genus *Miriquidica* (*Lecanorales*, *Lecanoraceae*) in Russia. Bibliotheca Lichenologica 88: 15–42.

Aptroot A, Seaward MRD. 1999. Annotated checklist of Hong Kong lichens. Tropical Bryology 17: 57–101.

Aptroot A, Sparrius LB. 2003. New microlichens from Taiwan. Fungal Diversity 14: 1–50.

Galloway DJ. 2007. Flora of New Zealand Lichens. 2nd Edition. Lincoln, Manaaki Whenua Press.

Hertel H, Rambold G. 1987. *Miriquidica* genus novum Lecanoracearum (*Ascomycetes* lichenisati). Mitteilungen der Botanischen Staatssammlung München 23: 377-392.

Kirk PM, Cannon PF, Minter DW, Stalpers JA. 2008. Dictionary of the fungi. 10th edition. Wallingford, CAB International.

Knoph JG, Leuckert C. 1997. Chemotypes and distribution patterns of the non-saxicolous species of *Lecidella* (*Lecanoraceae*, *Lecanorales*). Bibliotheca Lichenologica 68: 129–134.

Lumbsch HT, Huhndorf SM. 2010. Myconet volume 14. Part one. Outline of *Ascomycota* – 2009. Fieldiana, Life and Earth Sciences 1: 1–42. http://dx.doi.org/10.3158/1557.1

Nash TH, Ryan BD, Diederich P, Gries C, Bungartz F. 2004. Lichen flora of the Greater Sonoran Desert Region, vol. 2. Tempe, Lichens Unlimited.

Obermayer W. 2004. Additions to the lichen flora of the Tibetan region. Bibliotheca Lichenologica 88: 479–526.

Orange A, James PW, White FJ. 2001. Microchemical methods for the identification of lichens. 2nd edition. London, British Lichen Society.

Rambold G. 1989. A monograph of the saxicolous lecideoid lichens of Australia (excl. Tasmania). Bibliotheca Lichenologica 34: 1–345.

Rambold G, Davydov E, Elix JA, Nash III TH, Scheidegger C, Zedda L (eds). 2015. LIAS light – a database for rapid identification of lichens. http://liaslight.lias.net/ (viewed online on 28 July 2015).

Roux C. 1983. *Clauzadeana* Roux, nova likengenro (*Clauzadeana* Roux, nouveau genre de lichen). Bulletin de la Société Linnéenne de Provence 35: 99–102.

Smith, CW, Aptroot A, Coppins BJ, Fletcher A, Gilbert OL, James PW, Wolseley PA. 2009. The lichens of Great Britain and Ireland. London, British Lichen Society.

Wei JC. 1991. An enumeration of lichens in China. Beijing, International Academic Publishers.

Zhang LL, Wang LS, Wang HY, Zhao ZT. 2012a. Four new records of lecideoid lichens from China. Mycotaxon 119: 445–451. http://dx.doi.org/10.5248/119.445

Zhang LL, Wang XY, Wang HY, Wang LS, Hur JS. 2012b. A new species and new records of saxicolous species of the genus *Lecidella* (*Lecanoraceae*) from South Korea. Bryologist, 115: 329–332. http://dx.doi.org/10.1639/0007-2745-115.2.329

Zhao X, Zhang LL, Zhao ZT. 2013. A new species of *Miriquidica* from China. Mycotaxon 123: 363–367. http://dx.doi.org/10.5248/123.363